

WHAT IS CLAIMED IS:

1. A measuring system for measuring respiratory function including:

a first measuring unit for detecting volume change of a first measurement part of a subject sequent to respiratory movement;

a second measuring unit for detecting volume change of a second measurement part of the subject sequent to respiratory movement;

a control unit which acquires an output from said first measuring unit and said second measuring unit; and

an analyzing unit which analyzes the output which said control unit acquires;

said first measuring unit and said second measuring unit respectively include:

a sensing unit for sensing the volume change of the measurement part; and

a fixing unit for arranging said sensing unit to the measurement part;

wherein said fixing unit can fix said sensing unit in a manner of impressing said sensing unit on the measurement part.

2. The measuring system according to Claim 1 wherein:

the first measurement part is near thorax, and said

first measuring unit detects the volume change near thorax
sequent to costal respiration, and

the second measurement part is near abdomen, and said
second measuring unit detects the volume change near abdomen
sequent to abdominal respiration.

3. The measuring system according to Claim 1 wherein said
sensing unit senses the volume change of the measurement
part from change of pressure applied by said fixing unit and
the measurement part.

4. The measuring system according to Claim 1 wherein:

 said sensing unit has a bag-like form;
 said fixing unit has a belt-like form; and
 said sensing unit is impressed to the measurement part
in such a manner that a body of the subject is wrapped
around by said fixing unit.

5. The measuring system according to Claim 3 wherein:

 said sensing unit has a cavity inside;
 said measuring system further includes a pressure
sensor for measuring air pressure in the cavity; and
 the volume change of the measurement part is detected
from change of the air pressure in the cavity.

6. The measuring system according to Claim 5 further

including a pump for sending gas into the cavity.

7. The measuring system according to Claim 5 further including an initial pressure adjusting unit for adjusting the air pressure in the cavity to predetermined initial pressure by sending gas into the cavity before a measurement of respiratory function.

8. The measuring system according to Claim 7 wherein said initial pressure adjusting unit adjusts the initial pressure within a range where a ratio of the volume change to the change of the air pressure in the cavity is substantially constant.

9. The measuring system according to Claim 7 wherein said initial pressure adjusting unit adjusts the initial pressure within a range where a ratio of the volume change to the change of the air pressure in the cavity shifts substantially linear.

10. The measuring system according to Claim 7 wherein said initial pressure adjusting unit adjusts the initial pressure to be substantially constant when measuring a subject for a plurality of times.

11. The measuring system according to Claim 7 wherein said

initial pressure adjusting unit adjusts the initial pressure to be substantially constant when measuring a plurality of subjects.

12. The measuring system according to Claim 1 further including an indicating unit which indicates suitable respiratory movement to a subject according to the kind of data which should be measured.

13. The measuring system according to Claim 1 further including a condition input unit which receives an input of information about a measurement condition.

14. The measuring system according to Claim 13 further including a measurement control unit which controls said initial pressure adjusting unit or said indicating unit based on the measurement condition.

15. The measuring system according to Claim 14 wherein said measurement control unit determines the initial pressure which said initial pressure adjusting unit adjusts based on the measurement condition.

16. The measuring system according to Claim 14 wherein said measurement control unit determines a content which said indicating unit indicates to a subject based on the

measurement condition.

17. The measuring system according to Claim 1 further including a waveform generating unit for generating respiratory waveform data which shows respiratory state of a subject from the volume change near thorax which the first measuring unit detects, and the volume change near diaphragm which the second measuring unit detects.

18. The measuring system according to Claim 17 wherein said waveform generating unit weights the volume change near thorax and the volume change near diaphragm with a predetermined ratio when generating the respiratory waveform data.

19. The measuring system according to Claim 18 further including a calculating unit for calculating at least one respiratory function barometer among a lung capacity fraction, a forced expiratory curve, a forced lung capacity, a forced expiratory volume in one second, a forced expiratory rate in one second, a maximum mid-expiratory flow, a maximum ventilation volume, a flow volume curve, a peak expiratory flow rate, and a rate of abdomen contribution based on at least one of the volume change near thorax, the volume change near diaphragm and the respiratory waveform data.

20. The measuring system according to Claim 19 wherein said calculating unit calculates the respiratory function barometer, converting at least one of the volume change near thorax, the volume change near diaphragm, and the respiratory waveform data into respiratory volume.

21. The measuring system according to Claim 17 further including a waveform characteristic extracting unit which extracts a feature of waveform from at least one of the volume change near thorax, the volume change near diaphragm, and the respiratory waveform data.

22. The measuring system according to Claim 19 further including a respiratory tract state judging unit which judges state of constriction or blockage of a respiratory tract with reference to the respiratory waveform data, the forced expiration curve, or the flow volume curve.

23. The measuring system according to Claim 22 wherein said respiratory tract state judging unit judges that a respiratory tract of a subject is constricted or blocked in the case where the respiratory waveform data, the forced expiratory curve, or the flow volume curve has a waveform showing an increase of the air pressure in the cavity when the subject starts expiration.

24. The measuring system according to Claim 23 wherein said respiratory tract state judging unit judges a degree of constriction or blockage of the respiratory tract based on an aspect of increasing of the air pressure.

25. The measuring system according to Claim 1 further including a database which stores a medical view correspondent with at least one of a feature of the waveform of the respiratory waveform data, a feature of the waveform of the volume change near thorax, a feature of the waveform of the volume change near diaphragm, a difference of the waveform between the volume change near thorax and the volume change near diaphragm, a respiratory function barometer, and a personal data of a subject.

26. The measuring system according to Claim 25 further including a database referring unit which acquires the medical view for the subject with reference to said database.

27. The measuring system according to Claim 26 further including a display unit which displays the medical view.

28. A measuring apparatus for measuring respiratory function including:

a sensing unit for sensing volume change of a

measurement part of a subject sequent to respiratory movement; and

a fixing unit for arranging said sensing unit near the measurement part;

wherein said fixing unit has a belt-like form and can fix said sensing unit in a manner of impressing said sensing unit on the measurement part; and

said sensing unit senses the volume change of the measurement part from change of pressure applied by said fixing unit and the measurement part.

29. A measuring apparatus for measuring respiratory function including:

a first measuring unit for detecting volume change of a first measurement part of a subject sequent to respiratory movement; and

a second measuring unit for detecting volume change of a second measurement part of the subject sequent to respiratory movement;

said first measuring unit and said second measuring unit respectively include:

a sensing unit for sensing the volume change of the measurement part; and

a fixing unit for arranging said sensing unit near the measurement part;

wherein said fixing unit has a belt-like form and can

fix said sensing unit in a manner of impressing said sensing unit on the measurement part; and

said sensing unit senses the volume change of the measurement part from change of pressure applied by said fixing unit and the measurement part.

30. The measuring apparatus according to Claim 28 wherein said sensing unit has a cavity inside and includes a first connecting unit for sending gas which is in the cavity to a pressure sensor for measuring air pressure in the cavity.

31. The measuring apparatus according to Claim 30 wherein said sensing unit further includes a second connecting unit for connecting with a pump for sending gas into the cavity.

32. The measuring apparatus according to Claim 31 further including a control unit which includes said pressure sensor and said pump.

33. The measuring apparatus according to Claim 32 wherein said control unit further includes a recording unit which records the air pressure in the cavity which said pressure sensor measures.

34. The measuring apparatus according to Claim 33 wherein said recording unit records the air pressure in the cavity,

or data converted from the air pressure into the volume or respiratory volume in an external recording medium.

35. The measuring apparatus according to Claim 33 wherein said control unit further includes a transfer unit which transfers the air pressure in the cavity which said pressure sensor measures to an analyzing apparatus for analyzing respiratory function.

36. The measuring apparatus according to 32 further including an initial pressure adjusting unit for adjusting the air pressure in the cavity to predetermined initial pressure by sending gas into the cavity before a measurement of respiratory function.

37. The measuring apparatus according to Claim 36 wherein said initial pressure adjusting unit adjusts the initial pressure within a range where a ratio of the volume change to the change of the air pressure in the cavity is substantially constant.

38. The measuring apparatus according to Claim 36 wherein said initial pressure adjusting unit adjusts the initial pressure within a range where a ratio of the volume change to the change of the air pressure in the cavity shifts substantially linear.

39. The measuring apparatus according to Claim 36 wherein said initial pressure adjusting unit adjusts the initial pressure to be substantially constant when measuring a subject for a plurality of times.

40. The measuring apparatus according to Claim 36 wherein said initial pressure adjusting unit adjusts the initial pressure to be substantially constant when measuring a plurality of subjects.

41. An analyzing apparatus for analyzing respiratory function of a subject including:

a measurement data acquiring unit which acquires respiratory function measurement data of the subject; and
a calculating unit for calculating at least one respiratory function barometer among a lung capacity fraction, a forced expiratory curve, a forced lung capacity, a forced expiratory volume in one second, a forced expiratory rate in one second, a maximum mid-expiratory flow, a maximum ventilation volume, a flow volume curve, a peak expiratory flow rate, and a rate of abdomen contribution.

42. The analyzing apparatus according to Claim 41 wherein:
the respiratory function measurement data includes chest data acquired by measurement of volume change near

thorax and abdomen data acquired by measurement of volume change near diaphragm; and

 said analyzing apparatus further includes a waveform generating unit which generates respiratory waveform data which shows respiratory state of a subject from the chest data and the abdomen data.

43. The analyzing apparatus according to Claim 42 wherein said waveform generating unit weights the chest data near thorax and the abdomen data with a predetermined ratio when generating the respiratory waveform data.

44. The analyzing apparatus according to Claim 42 further including a waveform characteristic extracting unit which extracts a feature of waveform from at least one of the volume change near thorax, the volume change near diaphragm, and the respiratory waveform data.

45. The analyzing apparatus according to Claim 41 further including a respiratory tract state judging unit which judges state of constriction or blockage of a respiratory tract with reference to the respiratory waveform data, the forced expiration curve, or the flow volume curve.

46. The analyzing apparatus according to Claim 45 wherein said respiratory tract state judging unit judges that a

respiratory tract of a subject is constricted or blocked in the case where the respiratory waveform data, the forced expiratory curve, or the flow volume curve has a waveform showing an increase of the chest data or the abdomen data of the subject when the subject starts expiration.

47. The analyzing apparatus according to Claim 46 wherein said respiratory tract state judging unit judges a degree of constriction or blockage of the respiratory tract based on an aspect of increasing of the chest data or the abdomen data.

48. The analyzing apparatus according to Claim 44 further including a database referring unit which acquires a medical view for a subject with reference to a database which stores the medical view correspondent with at least one of a feature of the waveform of the respiratory waveform data, a feature of the waveform of the volume change near thorax, a feature of the waveform of the volume change near diaphragm, a difference of the waveform between the volume change near thorax and the volume change near diaphragm, a respiratory function barometer, and a personal data of the subject.

49. A program which makes a computer realize functions of:
acquiring respiratory function measurement data of a subject; and

calculating at least one respiratory function barometer among a lung capacity fraction, a forced expiratory curve, a forced lung capacity, a forced expiratory volume in one second, a forced expiratory rate in one second, a maximum mid-expiratory flow, a maximum ventilation volume, a flow volume curve, a peak expiratory flow rate, and a rate of abdomen contribution.

50. The program according to Claim 49 wherein:

the respiratory function measurement data includes chest data acquired by measurement of volume change near thorax and abdomen data acquired by measurement of volume change near diaphragm; and

further making a computer realize a function of generating respiratory waveform data which shows respiratory state of a subject from the chest data and the abdomen data.

51. The program according to Claim 50 further making a computer realize a function of weighting the chest data near thorax and the abdomen data with a predetermined ratio when generating the respiratory waveform data.

52. The program according to Claim 50 further making a computer realize a function of extracting a feature of waveform from at least one of the volume change near thorax, the volume change near diaphragm, and the respiratory

waveform data.

53. The program according to Claim 49 further making a computer realize a function of judging state of constriction or blockage of a respiratory tract with reference to the respiratory waveform data, the forced expiration curve, or the flow volume curve.

54. The program according to Claim 53 wherein it judges that a respiratory tract of a subject is constricted or blocked in the case where the respiratory waveform data, the forced expiratory curve, or the flow volume curve has a waveform showing an increase of the chest data or the abdomen data of the subject when the subject starts expiration.

55. The program according to Claim 54 wherein it judges a degree of constriction or blockage of the respiratory tract based on an aspect of increasing of the chest data or the abdomen data.

56. The program according to Claim 52 further making a computer realize a function of acquiring a medical view for a subject with reference to a database which stores the medical view correspondent with at least one of a feature of

the waveform of the respiratory waveform data, a feature of the waveform of the volume change near thorax, a feature of the waveform of the volume change near diaphragm, a difference of the waveform between the volume change near thorax and the volume change near diaphragm, a respiratory function barometer, and a personal data of the subject.

57. An analyzing server for analyzing respiratory function of a subject comprising:

a database stored respiratory function measurement data and a medical view correspondingly;

a receiving unit which receives a requirement of referring said database through a network;

a measurement data acquiring unit which acquires the respiratory function measurement data of the subject;

a database referring unit which acquires the medical view with reference to said database based on the respiratory function measurement data; and

a transmitting unit which transmits the medical view through the network.

58. The analyzing server according to Claim 57 wherein the respiratory function measurement data includes chest data acquired by measurement of volume change near thorax and abdomen data acquired by measurement of volume change near diaphragm.

59. The analyzing server according to Claim 58 wherein the respiratory function measurement data is respiratory waveform data generated using the chest data and the abdomen data.

60. The analyzing server according to Claim 59 wherein the respiratory waveform data is generated by weighting the chest data and the abdomen data with a predetermined ratio.

61. A rehabilitation assisting apparatus which assists rehabilitation of respiratory function comprising:

a pressurizing unit which includes a pressurizing member for squeezing a body of a subject; and a fixing unit for arranging said pressurizing unit to the body of the subject;

wherein said fixing unit has a bag-like form and can fix said pressurizing unit in a manner of impressing said pressurizing unit on the body; and

said pressurizing unit has a belt-like form and squeezes the body with increasing volume thereof by introducing gas therein.

62. The rehabilitation assisting apparatus according to Claim 61 wherein said pressurizing member is fixed so that said pressurizing unit squeezes an expectoration part of the

subject.

63. The rehabilitation assisting apparatus according to

Claim 62 wherein:

said pressurizing unit has a plurality of said
pressurizing members; and

said rehabilitation assisting apparatus further
comprises a control unit which controls volume of gas inside
said pressurizing members so that said pressurizing members
squeeze the expectoration part.

64. The rehabilitation assisting apparatus according to

Claim 61 comprising a plurality of said pressurizing units;
wherein said pressurizing units is arranged at least near
thorax and near diaphragm of the subject.

65. The rehabilitation assisting apparatus according to

Claim 61 further comprising a pressure sensor which measures
air pressure inside said pressurizing member; wherein
respiratory state of the subject is measured by sensing the
volume change near thorax or diaphragm from change of the
air pressure measured by said pressure sensor.

66. A method of measuring respiratory function including:

fixing a first measuring unit which includes a first
sensing unit for sensing volume change of a first

measurement part of a subject sequent to respiratory movement; and a first fixing unit for arranging said first sensing unit to the first measurement part, in such a manner that said first fixing unit pinches said first sensing unit between said first fixing unit and the first measurement part;

fixing a second measuring unit which includes a second sensing unit for sensing volume change of a second measurement part of the subject sequent to respiratory movement; and a second fixing unit for arranging said second sensing unit to the second measurement part, in such a manner that said second fixing unit pinches said second sensing unit between said second fixing unit and the second measurement part;

measuring simultaneously the volume change of the first measurement part sensed by said first sensing unit and the volume change of the second measurement part sensed by said second sensing unit.

67. The method according to Claim 66 wherein the first measurement part is near thorax and the second measurement part is near diaphragm.

68. The method according to Claim 66 wherein:

said first fixing unit and said second fixing unit have belt-like forms;

said first sensing unit and said second sensing unit have bag-like forms;

said fixing fixes said first fixing unit and said second fixing unit in such a manner that a body of the subject is wrapped around by said first fixing unit and said second fixing unit; and

said measuring measures the volume change by sensing air pressure inside said first sensing unit and said second sensing unit.

69. The method according to Claim 68 further including, between said fixing and said measuring, adjusting the air pressure inside said first sensing unit and said second sensing unit to predetermined initial pressure by sending gas into said first sensing unit and said second sensing unit;

wherein said measuring measures maintaining an amount of gas introduced into said sensing unit in said adjusting.

70. A method of assisting rehabilitation of respiratory function including:

equipping a subject with a pressurizing unit which comprises a pressurizing member for squeezing a body of the subject and a fixing unit for arranging the pressurizing unit to the body;

squeezing the body of the subject by the pressurizing

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member;

a rehabilitation step of making the subject perform respiratory movement under squeezing;

a first measurement step of measuring respiratory state of the subject by sensing pressure applied to the pressurizing member while said rehabilitation step.

71. The method according to Claim 70 wherein:

the fixing unit has a belt-like form;

the pressurizing member has a bag-like form;

said equipping fixes the pressurizing unit in such a manner that the pressurizing member is pinched between the fixing unit and the body of the subject;

said squeezing squeezes the body with increasing volume of the pressurizing unit by introducing gas into the pressurizing unit.

72. The method according to Claim 71 wherein:

said equipping equips the subject with the pressurizing unit so that the pressurizing unit squeezes an expectoration part of the subject;

said squeezing squeezes the expectoration part by adjusting air pressure inside the pressurizing unit.

73. The method according to Claim 70 further including after said rehabilitation step:

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adjusting air pressure inside the pressurizing unit to predetermined pressure;

a second measurement step of measuring respiratory state of the subject after rehabilitation by sensing the air pressure inside the pressurizing unit.

74. The method according to Claim 70 further including evaluating appropriate value of pressurizing to squeeze the body in said rehabilitation step based on the respiratory state of the subject measured in said first measurement step.

75. The method according to Claim 73 further including evaluating effect of said rehabilitation step based on the respiratory state of the subject measured in said second measurement step.